INFORMATION BEHAVIOR FOR SHRIMP FARM MANAGEMENT INFORMATION SYSTEM USING HIERARCHICAL MULTILEVEL STAKEHOLDER APPROACH FOR SMALL-SCALE SHRIMP AQUACULTURE IN THAILAND

Thanapat Yeekhaday
Technopreneurship and Innovation Management,
Chulalongkorn University, Bangkok, Thailand

Veera Muangsin
Department of computer Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok, Thailand

Chupun Gowanit
MaungThai Insurance PCL,
Bangkok, Thailand

Abstract- The purpose of this paper is to define the information behaviors for small scale intensive shrimp farmers and develop framework for shrimp farm information system management based on hierarchical multilevel stakeholder approach. This study was qualitative research which used multiple techniques for example in-depth interviews, observation, and field survey were conducted to collect data. The study found small-scale shrimp farmers need and search/seek information depend on the situation of actions which are in 3 hierarchical levels: 1) Coastal landscape and farm site, 2) Shrimp pond and farm development, and 3) farmers community/club involvement. Small-scale shrimp farmers require information in six situation of actions which are: 1) Shrimp business planning; 2) Shrimp farm site planning; 3) Shrimp pond aquaculture management; 4) Shrimp culture / production management; 5) Shrimp harvested; and 6) Community data/information/knowledge management. Shrimp farmers use information in decision support, business planning, risk management, improvement for farm culture practice, development of product quality, traceability, increasing income, group decision making, and exchange of information and knowledge among club/community farmers. This research also examines small-scale shrimp farmers' information needs and how to extent those needs to functional requirements for future development of shrimp farmer information system management system in related hierarchical multilevel stakeholders.

Keywords- Information behavior, Shrimp farm management information system, Hierarchical multilevel stakeholder, Shrimp farm in Thailand.

I. INTRODUCTION

Currently, the managerial tasks in agriculture are shifting to a new paradigm, requiring more attention on the interaction with the surroundings, namely environmental impact, terms of delivery,
documentation of quality, sustainability and growing conditions[1]. In general, this change of conditions for the managerial tasks on the farm has necessitated the introduction of more advanced activities monitoring systems and information system management to secure compliance with the restrictions and standards in terms of specific production guidelines, provisions for environmental compliance management standards, reduce risk and loss, increase productivity and marketing benefit[2]. According to Nisansala mentions that [3] agricultural information is an important factor that interacts with other production factors such as land, labor, capital and managerial ability. Demiryurek [3] also defines that information within the hands of the farmers means empowerment through control over their resources and decision making processes. However, the acquisition and analysis of information still proves a demanding task, since information is produced from many sources and may be located over many sites and is not necessarily interrelated and collaborated. The potential of using these data will reach its full extent when suitable information systems are developed to achieve beneficial management practices [4].

The role of information has been acknowledged as an important aspect in farmers activities[5]. However, better understanding of the information needs and information seeking behavior of farmers is fundamental for their achievement and participate interaction. According to Spink and Cole [6] mention that the study of information behaviors (IBs) is important for human resource, as it enables people to access and receive data, news and basic information are necessary for their lives. Government and related organizations should understand IBs for planning the information services that should cover the basic rights of the population and their requirements. Information resources should be provided and responded directly to the users’ requirement[7]. Savolainen[8] conceptualized information need which are necessary into three contexts namely, the situation of action, the task performance as it relates to work procedures and solutions to the relevant problems, and work role includes the dialogue context or the question-negotiation process in reference interview.

Thailand has been the world’s leading exporter of cultivated shrimp since the mid-90’s [9]. The culture species is mainly Pacific white shrimp (Penaeus vannamei) with over 90% of culture production has been exported, and over 1 million people involved in the shrimp industry supply chain. However, in Thailand most of shrimp farmers are small-scale producers (less than 10 Rais (1.6 ha) of farming area[10]), as in 2016 there were 20,000 shrimp farms covering 200,000 Rais (32,000 ha)[11]. Shrimp farming is a sector with a very high degree of diversity, involving a wide range of species, farming systems and production practices, and farming locations. According to Shang et al.[12] shrimp culture systems can be broadly classified into three types based on major economic and technological differences are extensive, semi-intensive and intensive [13]. The details are as following : the extensive is low input systems characterized by low stocking densities, little or no external nutritional inputs, tidal water exchange and shrimp yields of less than 500 kg/ha/yr; semi-intensive is use of supplemental feeding, intermediate stocking, occasional pumping of water and yields of 1-2 tones/ha/yr; intensive systems is high stocking density, formulated complete feeds, aeration and water pumping with yields of more than 2 tones/ha/yr; and most of shrimp culture system in Thailand currently using intensive system over 85% of all shrimp farms[14].
Although shrimp farming is a valuable and growing industry, its development has been accompanied by social, economic and environmental impacts. Thailand shrimp farm management involves an integrated planning process to address the complex management issues in the farm, social, community and coastal area and also could offer a holistic approach for addressing the impacts of shrimp farming on the coastal ecosystems[11].

The development and adoption of sustainable practices is required to shrimp farmers, investors, community, and government institutions. In general, agricultural land use system has many subsystems (or levels) to clarifying the conditions of management and sustainability. The system hierarchy classification, externalities between levels and tradeoffs among components can be traced and explicitly taken into consideration[15]. The integrated model of shrimp system hierarchical management practice in Thailand, Somsak and Ayut[16] introduce five levels based on the scale of the shrimps farm, social and environmental collaborate called “Hierarchical Multi-level Stakeholders” (as shows in Fig.1) which consists of 5 system levels are:-

System level 1: The coastal landscape framework for shrimp pond development. This level deals with the coastal landscape in its full complexity, these institution have to work together to develop the area that included zone for pond construction and operation or shrimp business development zones.

System level 2: Shrimp pond and farm development. Zone comprises of shrimp ponds and other kinds of ponds. It is necessary to run the shrimp farms, i.e., water-intake pond, water settling ponds and sludge storing ponds. These ponds are connected with the management of farms leading to an involvement of economic, environment, trade and social components of shrimp farmers. This level consists of 2 main operations are managing farm/pond operations and managing shrimp product.

System level 3: Community involvement. This system interconnects all shrimp farms and their environmental impacts and their impacts to the coastal ecosystem. This system is increasingly more complicated, therefore it involves some more components of the system and multi stakeholders level[16]. The components enter to play an important roles such as institutional, legal, as well as policy components countering with the biological, environmental, economic, market and social components.

System level 4: National involvement. The national development plan for shrimp farm to mitigate the impacts of shrimp farming to the coastal zone, but also impacts from other sources beyond the system levels 1 to 3 are involved.

System level 5: International involvement. It is inevitable that shrimp farming has to link with international trade agreement and negotiation.

![Fig. 1 Operation levels and activities in a Multi-level stakeholder approach to shrimp farming development.](Source: Somsak and Ayut. [16])

**II. PROBLEM STATEMENT**

"Information behavior" is the currently preferred term used to describe the many ways in which human beings interact with information, in particular, the
ways in which people seek and utilize information[17]. Difference kind of information are required by different kind of users for different purposes. The analysis of shrimp farm information system is a specific farming system and different information need and source of information. Small-scale shrimp farmers need information for decision support and management all hierarchical multi level. However, small-scale shrimp farmers in Thailand face many problems and challenges on IBs and information system management, such as poor of information support, unorganized data, information is out of date, no data sharing for group decision support, and lack of information management tools. According to the president of Thai frozen food association[18] he mentioned that "Thailand shrimp farmers are mostly small-scale size with management style based on previous experienced. Most of small-scale shrimp farmers, no information system nor decision support management tools."

By focus group interviewees from shrimp farmer cooperative members [19] commented that "In our shrimp farm management, We need information similarly, we only concern on information in pond and farm level. In cooperative group level, we communicate and share general basic data such as daily shrimp price, disease occurred, weather, and suggestion for problem solving via Line application and Facebook. We need shrimp production data sharing, but we do not have information management system for community level, so we don't know how much shrimp we have currently in our members farms. We don't know how much material and feed we need, so we can't control price, or can't use data to negotiate for our benefit"

By surveyed and observed in small-scale shrimp farm on data/ information management, found that most of small-scale shrimp farmers record data in "shrimp culture data record book" manually. There are no computer based or mobile application for shrimp culture data management. The shrimp culture data book record also record pond by pond and no financial or market price in part of book data record, so they don't know current financial of pond, or don't know the farm level of operation because of no technology to manage and integrate data internal and external, also in pond and farm levels and community level. According to Blackmore et al.[4] to be successful, the small farm manager must tune up three aspects of the farm business marketing, capital/ finance, and appropriate technology. Managers of small scale farms often experience great difficulty in properly managing these three problems to achieve a smooth running small-scale farm. They need information from all sources to help them manage their enterprises. By knowing about the shrimp small-scale farmers information needs and information seeking behavior of shrimp farmers could play a vital role in meeting their information needs effectively and able to examines farmers’ information needs and can be addressed through the use of information system management tools and applications appropriately [20].

II. THE RESEARCH OBJECTIVE

This paper conducted research to develop shrimp farmers IBs (Information need and Information seeking) and transfer their IBs to what extent those needs to information system functional requirement and settings of information system management techniques and tool application in each hierarchical multilevel related with small-scale shrimp farmers.

IV. METHOD OF RESEARCH

A. Study Area

The study area is Southern Thailand at Pakpanang.
rivers area, where is the shrimp zone culture promotion of Thailand. The area cover two districts of Nakornsridhamarat province (Huasai and Pakpanang districts) and there have over 400 of shrimp farmer cooperative members. (Pakpanang rivers’ shrimp cooperative). The objectives of the cooperative are 1) to promote and develop members for sustainable shrimp farm management; 2) to monitor data and information about shrimp production and market; 3) to monitor price situation; 4) co-operate with hatcheries to provide quality post-lava; 5) to monitor shrimps disease and warning to members; and 6) to support farming practice among members.

B. Interview and Sampling

This study used semi-structured interviews as the primary source of data. According to Savolainen [8] the interview technique is a good way to access people's perceptions, meanings, definition of situations and constructions of reality. The purpose of the interviews was to confirm the existence of IBs and record the details of small-scale shrimp farmers and made necessary to understand the IBs framework and sources of information used by the shrimp farmers when they are engaged in their production activities and managing their shrimp farms. Semi-structured interviews were conducted during August – December, 2016 with 20 small-scale intensive shrimp farmers and twelve of related shrimp industry (1 from Thai-frozen association, 2 from shrimp academicians and researchers, 3 from shrimp farm manager on large scale company, 2 from shrimps feed sale representative, 2 from hatcheries, and 2 from shrimp manufacturing and exporters). To ensure reliability and validity of the interview instrument, we first conducted a pilot study with a small group of shrimp producers (small-scale farmers under 10 Rais of shrimp farm area and own farm management). In the pilot study we tested and refined the interviews questions before conducting the main fieldwork.

C. Theory Validation Process

The researchers tested method reliability by methodological triangulation. Specifically, multiple data collection techniques were also used to increase the validity and reliability of the research. In-depth interviewing, recording the interview observation and group discussion techniques were also used to expand the interview. Additionally, each interview was transcribed and categorized by person, was discussed with each key informant and experienced again, so that he/she could add any additional information. This step had the intended effect of both confirming initial data and adding new, more detailed data. Moreover, we also participate on farm site data record and interview during shrimp culture and also harvested.

D. Coding Process

Coding was set by selection of statements that correlated to the aim of research and conceptual framework. These statements were then conceptualized, which was possible by reading understanding and analyzing the intended meanings and then we categorized data based on theoretical framework.

The concept and category of each set of data were analyzed with emphasis on modification of categories and development of shrimp farmers’ information behavior model based on 3 level of hierarchical multilevel stakeholder approach which directly related with smallscale shrimp farmers’ operation activities. The model was designed based on three contexts of IBs Sovolianen[8] namely, the situation of action, task performance, and dialogued context for negotiation process.

V. ANALYSIS AND DISSCUSSION

A. Situation of Action Each System Level
The categories of shrimp farm information are required to perform multilevel hierarchical management. At hierarchical system level 1, assessment of farm site selection and shrimp farm business plan. The situation of action in this system level include shrimp farm business design and shrimp farm business plan.

The hierarchical system level 2, managing shrimp farming operation. This system level consists of two suboperations are 2.1) managing pond production and type of shrimp farming techniques. The situation of action is shrimp pond aqua management. Operation 2.2) Managing shrimp production, situation of action consists of shrimp culture management and shrimp harvested.

The hierarchical system level 3, managing local shrimp production club or shrimp community. The situation of action concern with information and knowledge sharing, group decision support, minimize risk from external sources, minimize and resolve conflict, improve income, and negotiation for members benefit.

B. Information Needs
Shrimp farmers’ information needs arise from their situation of action context in each operational level. These situation of action contexts have an impact on their needs for information, motivating them to feel they require some source of information to plan for farm pond operation and management, to solve some problems, to maintain water quality, to optimize feeding, to reduce risk, to increase task performance, and to get some data for negotiate with related suppliers. This correlated to the concept described by Savolainen[8] three contexts behind information needs, namely, situation of action, task performance and context of dialogue or negotiation process.

C. Information Seeking or Source of Information
Leckie et al. [21] identified two factors that can motivate information seeking. These are sources of information and an awareness of information. The data collected from the interviewed as well as the data from a primary recorded by shrimp farmers aimed at determining the role of potential sources of information related with shrimp farm management. Shrimp farmers source of information are categorized in to six sources are 1) from farmers themselves, such as previous experienced, shrimp culture data recorded; 2) from personal sources, such as family members, neighbors, friends, other shrimp farmers, sale representatives, labors, government officers, researchers, co-operative/community members; 3) from place types, such as others shrimp farm, community/cooperative center, demonstration farms, and academic institutions; 4) from mass media, such as television programs, newspapers, radio; 5) from related activities, such as exchange and sharing knowledge activities, exhibition, meeting / seminar, study trip and training; 6) from Internet and social media, such as Facebook and Line applications. This research correlated to Nisansala[20], who found that agriculture and rural community usually receive information from television program, magazine, website, journal and books, commercial agriculture suppliers and consultants, societies and organization, and government officers.

D. Using IBs to design shrimp farm management Information System application for task performance
IBs are the relationship pattern in situation need for information, information seeking and use of information by shrimp farmers in their information system management and decision making. The situation of action triggers farmers to require information or more information is their need for
decision making and increase farm management practices. Small-scale shrimp farmers have continually confronted the situation differs in each hierarchical level. This was the reason behind their need information system management and tools to decision making and increase task performance in each level. After we know situation of action and information need in each system level, then we summarized functional requirement and designed source of information and proposed information system management solution and application in each hierarchical system level. As depicts in Fig. 2 Information needs and source of information in situation of three levels in hierarchical multilevel stakeholders. In situation of action 1 (assessment of shrimp farm site) by develop GIS system to manage data sources and temporal environmental quality parameters, shrimp healthy record or disease warning collaboration. In situation of action 2 (shrimp farm business plan) by develop financial decision support model or production estimation model to assists farmers decision making before business start. In the situation of action 3 (shrimp pond aqua management) by develop pond/farm daily activity database, post larvae and hatchery database, prediction and optimization model, financial model, automated remote sensing system. The situation of action 4 and 5 (shrimp culture/production management and shrimp harvested) by develop shrimp daily activity database (such as average dairy grain(ADG), and feed conversion rate(FCR)), shrimp health record and prediction, shrimp growth prediction model, and shrimp financial model. The situation of action 6 (Managing local shrimp production clubs/community) by develop group decision support system, group culture planning system, group stocking density on GIS based, community resource need management system and knowledge management system.

VI. CONCLUSIONS
Recently, computer science and information systems communities have equated information requirements of users with the way users behave in relation to the systems and information available[22]. In other words, investigations into information requirements were concerned almost entirely with how a user behave with data and information in proposed system. Shrimp farmers currently, started to address information system concern. By knowing about shrimp farmers information behaviors both information needs and information seeking could play a vital role in meeting their information needs effectively and able to examine information needs and can be addressed through the use of ICT tools and applications appropriately. This research aimed at study on IBs of small-scale shrimp farmers in Thailand. The research framework based on operational levels and activities in multi-level stakeholder approach model. Pakpanang river shrimp zone culture promotion area is selected for research study. This study was qualitative research in-depth interviews, observation, and field survey were conducted to collect data. Small-scale shrimp farmers require information depend on situation of action, information need in each situation of action and source of information in information need.

This research has shown the benefit of using IBs as a preliminary step to the actual design of a novel shrimp farm management information system analysis method. It has been shown that use of IBs allows a fundamental analysis, incorporating the information need and source of information in related management levels. The unstructured content analysis of qualitative research enables the identification of existing functional requirement and possible solution (IS
management tools or applications). The next step for future research will involve detailing and specifying the information flow and system analysis and design for multilevel stakeholder shrimp farm management information system by integrate with mobile application and GIS system.

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Fig.2 Small-scale shrimp farmers IBs and information system functional requirement in hierarchical multilevel stakeholders

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